

Supplementary notes on the American species of *Strychnos*-XI

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Introduction

Since the last in this series of papers was submitted for publication 131 new collections have been studied by the senior author, largely on visits in 1970 and 1971 to six herbaria in Colombia and Brazil, six herbaria in Europe, and five in United States. An extensive and particularly interesting set of *Strychnos* collected largely by R.A.A. Oldeman in French Guiana was received on loan from Herb. Centre Cayenne. French Guiana has been poorly collected in recent times, a fact reflected in this collection. Nine of the 14 species of *Strychnos* known to occur in that country (see 7a:84, and note that *S. eugeniifolia* and *S. oiapocensis* were collected after this paper was published) were represented, and one, *S. panurensis*, is recorded for the first time.

No nomenclatural changes are proposed in this paper. Range extensions for ten species are noted, and a study of tendrils in the American members of the genus is presented. The following new herbarium symbol is used:

CAY: Herbarium du Centre Cayenne

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TENDRILS IN AMERICAN STRYCHNOS

In his monograph of African *Strychnos*, Leeuwenberg (Meded. Landbouwhogeschool Wageningen 69(1):12, 1969) calls attention to three types of tendrils that occur in the genus, and suggests that they may provide useful taxonomic characters. The three types, all of which are presumed (from their axillary position) to be modified branchlets, seem not to be different except in position relative to each other. They may be described briefly as:

- I. Solitary, opposed to a bract or to a developed leaf (exceptionally to a branchlet).
- II. Opposite and terminal to a branchlet, forming a sort of anchor-shaped grapple.
- III. Serial in 2--3 pairs at successive nodes of a leafless branchlet.

In order to test the utility of the character in the taxonomy of American *Strychnos* Barneby has reviewed all material of the genus preserved at NY, and below we present a summary of his findings. As was of course known to Leeuwenberg, the absence of tendrils from a specimen does not mean its absence in the species, for they are found only on particular shoots of a given plant; inevitably, therefore, much of our data is of a negative value. It appears, however, well demonstrated that Type I (solitary) is the predominant sort in American *Strychnos*. Type II (paired) has been seen in *S. chlorantha*, *S. grayi*, and *S. nigricans*. The serial type III, described by Leeuwenberg for several African species, is found with us only in *S. brachistantha*. Individual cases of transition from one type to another, and individual exceptions from what seems the general rule in a given species, are not infrequent. In nine species we found two types of tendril, sometimes in parts of a single collection.

Generally speaking we failed to find any strong correlation between tendril-type and major groupings within our species as these have been worked out on the basis of other morphological characters. We note with interest the diversity in tendril-type encountered in the species of subsect. *Eriospermae*. Assuming that this is a natural group, we conclude that at least in this context the tendril character can have no taxonomic value above the level of species. The species of sect. *Breviflorae* as a whole are exceptionally difficult to separate without fruits, and tendrils, if found to be truly characteristic of each species, could be useful here in determination of sterile specimens. Our study of tendrils in sect. *Strychnos* (*Longiflorae*) and *Intermediae* was disappointing in the sense that it shows little promise of furnishing taxonomically useful information.

TENDRILS IN SECTION STRYCHNOS
(Summary)

Solitary (type I) only.....25 species

Solitary (type I) and several exceptions (see under <u>S. trinervis</u> , <u>S. peckii</u> and <u>S. erichsonii</u>).....	3	species
Paired (type II) only (<u>S. chlorantha</u>).....	1	"
Paired (type II) and several exceptions (see under <u>S. ramentifera</u> and <u>S. jobertiana</u>).....	2	"
Tendrils none (<u>S. pseudo-quina</u>).....	1	"
Tendrils of these species are not known but expected to occur (<u>S. asperula</u> , <u>S. lobelioides</u>).....	2	"
Specimens with tendrils are not available at NY (<u>S. colombiensis</u> , <u>S. araguaensis</u> , <u>S. xinguensis</u> , <u>S. pubiflora</u>).....	4	"
Total.....		38 species

TENDRILS IN SECTION ROUHAMON (AUBLET) PROGEL
(Summary)

Solitary (type I) only.....	5	species
Solitary (type I) only (probably) (<u>S. melinoniana</u>).....	1	"
Solitary (type I) and an exception (<u>S. guianensis</u>).....	1	"
Tendrils none (<u>S. hirsuta</u>).....	1	"
Tendrils of this species are not known but expected to occur (<u>S. goiasensis</u>).....	1	"
Specimens with tendrils are not available at NY (<u>S. duckei</u>).....	1	"
Total.....		10 species

TENDRILS IN SECTION BREVIFLORAE PROGEL
SUBSECTION BREVIFLORAE
(Summary)

Solitary (type I) only.....	5	species
Solitary (type I) and several exceptions (<u>S. castelnaeana</u>).....	1	"
Paired (type II) only (<u>S. grayi</u>).....	1	"
Tendrils none (<u>S. progeliana</u> , <u>S. oiapocensis</u> , <u>S. fendleri</u> , <u>S. brasiliensis</u>).....	4	"
Tendrils not seen (<u>S. rubiginosa</u>).....	1	"
Total.....		12 species

TENDRILS IN SECTION BREVIFLORAE PROGEL
SUBSECTION ERIOSPERMAE Krukoff & Barneby
(Summary)

Solitary (type I) only (<u>S. poeppigii</u>).....	1	species
Solitary (type I) and several exceptions (<u>S. mattogrossensis</u> , <u>S. schultesiana</u>).....	2	"
Faired (type II) only (<u>S. nigricans</u>).....	1	"

Serial in 2-3 pairs (type III) (<u>S. brachistantha</u>).....	1	species
Tendrils none (<u>S. cerradoensis</u> , <u>S. tarapotensis</u>).....	1	"
Tendrils of these species are not known but expected to occur (<u>S. neglecta</u>).....		
Specimens with tendrils are not available at NY (<u>S. pachycarpa</u> , <u>S. malocosperma</u>).....	2	"
Total.....	10	species

I. SECTION STRYCHNOS

1. chlorantha - II - Barquero 101, 102 A.
2. ramentifera - II - Froes 21817; Ducke 1762.
I - Froes 20822.
3. colombiensis - specimens with tendrils are not available at NY.
4. asperula - tendrils of this species are not known but expected to occur.
5. romeu-belenii - I - Romeu Belem 3509.
6. rondeletioides - I - Froes 11986/2, 21283a, 21286, 22238, 23840; Black 48-2634 and many others.
7. macrophylla - I - Froes 20488, 25250; Ducke 1895, 1975.
8. barnhartiana - I - Froes 20830.
9. araguaensis - specimens with tendrils are not available at NY.
10. brachiata - I - Schultes 3602; Black 48-2948; Krukoff 10864.
11. trinervis - I - Romeu Belem 3573, 3725; Duarte 6430; Froes 12679/44, 12716/103.
Exception: Klein 820 has a shoot ending in a terminal tendril, obviously an exception or teratological.
12. panamensis - I - Standley & Padilla 2559; R. S. Williams 389; Woodson et al. 1517; Pittier 4007; Allen 4573; Steyermark 99831, 101926, 101990; deBruijn 1424.
13. tabascanana - I - Lundell 6095; Steyermark 41542, 45862; Standley 24302, 73143; Barquero 104.
14. divaricans - I - Ducke 2309; Black & Foster 48-3364; Ducke s.n. (Jard. Bot. Rio 22362 (photo of isotype, B; Field Neg. (8193).
Romeu Belem 1818, 1825, 3472, 3500, 3581, 3681, 3706, 3714.
15. bahiensis - I - Geijskes 1037.
16. eugenifolia - I - Ducke s.n. (1945).
17. krukoffiana - I - Sagot 398; N. T. Silva 1758; Froes 20034.
18. medeola - I - Froes 12073, 23172; Krukoff 7539, 8935; A. C. Smith 3678; Wilson-Browne 560.
19. toxifera - I - Froes 23197, 23384, 23473, 23510, 23515A; Ducke 1645, 1711; Prance & Penna 2092; Lanjouw & Lindman 2743; N. T. Silva 3036; Steyermark 97583; Forest Department (Guiana) 5824.
20. tomentosa - I - Forest Department (Guiana) 2473.
21. diaboli - I - Forest Department (Guiana) 2473.

22. javariensis - I - Krukoff 7655; Ducke 1770; Schultes & Black 8401.
23. sandwithiana - I - Ducke s.n.; Froes 20935; Krukoff 9073, 9081.
24. jobertiana - I - Krukoff 7799; Schultes 10091; Idrobo 2627.
I plus II - Krukoff 7788, 8009.
II - Froes 12063; Krukoff 7786, 7829, 8024, 8678; Prance & Silva 58713; Steyermark 57910; Schultes & Black 8306.
25. pseudo-quina - tendrils none.
26. xinguensis - specimens with tendrils are not available at NY.
27. amazonica - I - Ducke 2007; Krukoff 9061; Pires 29; Froes 21822; N. T. Silva 1299.
28. solimoesana - I - Froes 12712/106, 19930, 20033, 20923, 23551; Krukoff 7790; Ducke 362; Romeu Belem 3703.
29. froesii - I - Ducke 2272; Froes 31328, 32169, 32395.
30. lobelioides - tendrils of this species are not known but expected to occur.
31. peckii - I - many, not listed.
III plus transition between III and I plus I - Krukoff 7631.
32. erichsonii - I - many, not listed.
Exceptions: coll. undesign. (16/VII/39) has leafless axillary shoots with solitary serial tendrils; probably a minor modification of I. Froes 20361, 20389 have tendrils derived from a branchlet of inflorescence.
33. gardneri - I - Prance 58252.
34. pubiflora - specimens with tendrils are not available at NY.
35. bredemeyeri - I - A. C. Smith 2278; Bredemeyer s.n. (photo of the holotype at W, NY Neg. 6109).
36. mitscherlichii sens. lat. - I - many, not listed.
37. solereideri - I - Krukoff 7800, 9059, 9083, 9088, 9095, 9096.
38. darienensis - I - Froes 12069, 21064, 21805, 24378, 29641; Krukoff 8444, 10936; Schunke 3445; A. C. Smith 2837; Pires 3721; Ule 5184 (photo of the specimen at B, Field Neg. 3870, the basis of the name S. ulei).

SECTION ROUHAMON (AUBLET) PROGEL

39. guianensis - I - Oldeman B-947; Schmidt s.n.; Geijkes 1032; Stahel 98; A. C. Smith 2836.
Exception: Black & Ledoux 50-10704 has

- a solitary tendril opposed to flower cymule.
40. glabra - I - A. C. Smith 2980; Krukoff 8371, 9090, 9098, 9101; Froes 22632; Maguire 56099.
41. subcordata - I - Black 49-8180; Froes 20471, 20798, 21153, 23900A, 25729; Krukoff 7957; Ducke 708; Glaziou 22753 (photo); Spruce 2087 (photo).
42. bicolor - I - Warming 1144 (photo).
43. panurensis - I - Froes 21704; Croizat 43; Wurdack et al. 41281, 43072.
44. goiasensis - tendrils of this species are not known but expected to occur.
45. duckei - specimens with tendrils are not available at NY.
46. hirsuta - tendrils none.
47. cogens - I - A. C. Smith 2272, 2444, 3598; Krukoff 8001; Froes 21261.
48. melinoniana - Lanjouw & Lindman 2621, has one detached tendril, probably type I.

SECTION BREVIFLORAE PROGEL

SUBSECTION BREVIFLORAE

49. parviflora - I - Krukoff 7798, 7819, 9072, 9087, 9104; Froes 12053.
50. castelnaeana - I - Krukoff 7548, 7588, 7592, 7596, 7600, 7602, 7781, 7808, 7811, 8679 and others.
- III - (or transition to III) Froes 29036; Krukoff 7649 (sheet 2), 7653.
51. progeliana - tendrils none.
52. oiapocensis - tendrils none.
53. fendleri - tendrils none.
54. atlantica - I - Romeu Belem 3724.
55. rubiginosa - tendrils not seen.
56. parvifolia - I - Mello Filho et al. OVB-68; Romeu Belem 3704; Ducke & Lima 18; Ducke 1981; Froes & Black 24856; Froes 26981.
57. fulvotomentosa - I - Ducke 2283.
58. acuta - I - Ducke 2282; Mello Filho OVB-10; Romeu Belem 3880.
59. brasiliensis - tendrils none.
60. grayi - II - Bro. Alain 2912; Jack 5505; Bro. Leon 662; Ekman 3406.

SUBSECTION ERIOSPERMAE Krukoff & Barneby

61. pachycarpa - specimens with tendrils are not available at NY.
62. neglecta - tendrils of this species are not known but expected to occur.
63. brachistantha - III - Lundell 6266.
64. nigricans - II - Mello Filho et al. 537.
65. mattogrossensis - I - Ducke s.n. (1949); Romeu Belem 3512; Ducke 1613; Froes 20634.

- | | | |
|-----|-------------------------|---|
| | I plus II | - <u>Ducke</u> s.n. (1945), s.n. (1949). |
| | II | - <u>Romeu Belem</u> 3874; <u>Froes</u> 20034. |
| 66. | <u>cerradoensis</u> - | tendrils none. |
| 67. | <u>schultesiana</u> - I | - <u>Breteler</u> 3973. |
| | I plus II | - <u>Breteler</u> 4940. |
| 68. | <u>malacosperma</u> - | specimens with tendrils are not available at NY |
| 69. | <u>poepigii</u> - I | - <u>Froes</u> 20806; <u>Ule</u> 5185 (photo). |
| 70. | <u>tarapotensis</u> - | tendrils none. |

CHEMICAL STUDIES OF THE AMERICAN SPECIES OF STRYCHNOS

In Supplement VII of this series (7a:87) are listed 25 species which had been studied chemically since the early thirties. In Supplement VIII (7b:78) five newly studied species were reported. Here we are able to add six more names to the list: S. romeu-belenii, S. tabascanana, S. pseudo-quina, S. hirsuta, S. atlantica, and S. brasiliensis; and new data are presented under S. panamensis. For details see below.

Collection of samples for chemical assay is still actively pursued by the senior author. Collecting currently in Brazil are G. France, J. Murca Pires, and Nilo Silva on the Amazon, Romeu Belem in State of Bahia, and the mateiros working under direction of H. Irwin on the Central Plateau; and in Peru Jose Schunke V. A summary of progress since 1965 on chemical studies of bark of American Strychnos now in preparation by Prof. G. B. Marini-Bettolo and Dr. N. G. Bisset will be published in the next paper. Of 70 species known in America 36 have now been investigated chemically.

CHEMICAL STUDIES OF THE AUSTRALASIAN AND AFRICAN SPECIES, by N. G. BISSET

AUSTRALASIAN.

From the chemical (alkaloid) point of view, work has hardly progressed beyond the stage of acquiring basic information about the nature of the alkaloids present, and most attention has been directed towards those found in various parts of S. nux-vomica. As yet, however, no systematic chemical examination of these various parts, or of other species, has been undertaken, although this will have to be done as a first step towards obtaining an understanding of the biochemical processes which take place in relation to the plant's alkaloids. Nevertheless, a start has been made with elucidating the biosynthesis of strychnine and similar bases (see below).

Recent findings are set out in the following table:

S. NUX-VOMICA L.

Seeds: Additional alkaloids - pseudobrucine, pseudo- α -

-colubrine, pseudo- β -colubrine, and two others as yet unidentified but possibly the N-oxides of strychnine and brucine^{1, 2}

Young leaves: Strychnine, β -colubrine, brucine, icajine, vomicine, novacine^{3, 4}

Stem bark: Strychnine, α -colubrine, β -colubrine, brucine, pseudostrychnine, pseudobrucine⁵

Root and root bark: Strychnine, brucine, pseudostrychnine, pseudobrucine^{1, 4}

Both the young leaves and the stem bark have been found to contain much alkaloid, up to 8 and 9%, respectively. It has been observed that the roots and root bark contain little or no icajine, vomicine, and novacine - the so-called N-methyl-pseudo bases - while the alkaloid mixture of the leaves comprises as much as 40% of these compounds; this finding is taken to be of possible biogenetic significance.^{3, 4} Studies on the biogenesis of strychnine reveal that the roots are the probable main production centre, with little being produced in the leaves, and that there is not much transport of strychnine to the leaves.⁶ This fits in with an observation by Denoël and co-workers on African Strychnos species, that loganin-type compounds, from which the non-indole part of the alkaloids is derived, are absent from the leaves.⁷ The seeming absence of N-methyl-pseudo bases in the root bark and stem bark of S. nux-vomica and their presence in high proportion in the leaves therefore suggests that these bases may well be formed in the leaves, probably from alkaloids of the strychnine type.

Diaboline - the one alkaloid so far found in species from all three parts of the world where Strychnos occurs and which is an obvious candidate as a biogenetic intermediate - has been shown by radioactive tracer experiments not to be converted into strychnine in S. nux-vomica. It is therefore not a direct precursor of this base. A similar result has been obtained with N₂-deacetyldiaboline.⁶

AFRICAN.

Phytochemical and pharmacological screening of 23 species has been carried out.⁸ Pronounced differences in alkaloid pattern and pharmacological effects were noted. Both convulsant (strychnine-like) and muscle-relaxant (curarizing) activities were found, implying the simultaneous presence of tertiary and dimeric quaternary alkaloids in some species.

Over 200 samples of leaves, belonging to 69 of the 75 recognized African species, have been screened for tertiary alkaloids; only about a dozen species have more than 0.1% alkaloid in the leaves. Strychnine and similar bases appear to be of rare occurrence and are probably present in only about half-a-

-dozen species, but again the alkaloid patterns show considerable variation. From an alkaloid point of view, the leaves are the least satisfactory material to work with, because of the generally low yield of alkaloids, but are easiest to obtain - in small amounts, at least - as herbarium fragments.⁹

Nevertheless, a systematic study of the various plant parts is still lacking.

A detailed review of the ethnobotany of African Strychnos is in course of publication.¹⁰

Recent chemical findings are set out in the following table:

S. HENNINGSII Gilg

Additional alkaloids - O-acetylhenningsoline and 8,13-dehydrodiaboline (South African material)¹¹

Tsilanine and 2-methoxytsilanine and their O-demethyl derivatives (Madagascar material)¹²

The tsilanine alkaloids are evidently related to holstine,¹³ previously isolated from Congo (Kinshasa) material.

S. ICAJA Baill.

Strychnine, 4-hydroxystrychnine, pseudostrychnine, icajine, vomicine, 14-hydroxyicajine, 21,22- α -epoxyvomicine, 21,22-epoxy-N-methyl- β -pseudo- β -colubrine, 21,22- α -epoxy-3-methoxyvomicine, 21,22- α -epoxynovacine, 14-hydroxy-21,22- α -epoxyicajine, 14-hydroxy-21,22- α -epoxyvomicine, 14-hydroxy-21,22- α -epoxynovacine¹³

This well-known ordeal-poison plant¹⁴ is so far unique among African species in that it exhibits convulsant activity only. The alkaloids responsible are strychnine and 4-hydroxystrychnine¹⁵ and this is the first time that strychnine has unequivocally been shown to be present in an African Strychnos species. The other bases present have little pharmacological activity. Like S. nux-vomica, in S. icaja the N-methylated bases are found in high proportion in the leaves, while the strychnine and 4-hydroxystrychnine predominate in the root bark - the plant part used to make the poison.

S. SPLENDENS Gilg

Additional alkaloids - isostrychnosplendine and its N₂-acetyl derivative, splendoline, isosplendoline, isosplendine¹⁶

Of interest is the reported isolation of retuline and splendine-type alkaloids from the South American S. brasiliensis,¹⁷ which further emphasizes the chemical relationships between the geographically separated groups of species.

1. G.B. Marini-Bettolo et al., J. Assoc. off. analyt. Chem. 51 185-191. 1968.
2. C. Galeffi et al., J. Chromatog. 45 407-414. 1969.
3. P. Šeřčovič et al., Planta med. 16 143-146. 1968.
4. W. Maier & D. Gröger, Pharm. Zentralhalle 107 883-885. 1968.
5. P.L. Rajput & C.K. Atal, Indian J. Pharm. 31 87-88. 1969.
6. Ch. Schlatter et al., Helv. chim. Acta 52 776-789. 1969.
7. A. Denoël et al., Contribution à l'étude des Strychnos du Congo Belge. Ministère des Colonies. Bruxelles. 1953.
8. F. Sandberg et al., Acta Pharm. Suecica 6 79-102. 1969.
9. N.G. Bisset & J.D. Phillipson, Lloydia 33 in press.
10. N.G. Bisset, Lloydia 33 in press.
11. M. Spitteller-Friedmann & G. Spitteller, Liebigs Ann. Chem. 711 205-220. 1968; *ibid.*, 712 179-194. 1968.
12. R. Sarfati et al., Phytochemistry 9 in press.
13. N.G. Bisset, "Alkaloids of some African species of Strychnos", Ph.D. Thesis, University of London. 1968; Tetrahedron Lett. 3107-3110. 1968.
14. N.G. Bisset & A.J.M. Leeuwenberg, Lloydia 31 208-222. 1968.
15. F. Sandberg et al., Acta Pharm. Suecica 6 103-108. 1969.
16. M. Koch et al., Ann. Pharm. franc. 27 229-238. 1969.
17. G.B. Marini-Bettolo, Farmaco, sci. ed., 25 150-162. 1970.

1. Strychnos chlorantha Progel, Mart. Fl. Bras. 6(1):273. 1868.

Costa Rica: Puntarenas: forest road above entrance to Laguna, San Vito del Java, B. G. Schubert 1267 (US).

This collection, made on March 17, has mature fruits + 4.3 cm in diam with shells + 9 mm thick.

5. Strychnos romeu-belenii Krukoff & Barneby, Mem. N.Y. Bot. Gard. 20(1):22. 1969.

From the stem bark of this species (Romeu Belem 3504 - cited in 7d:179) a new indolinic alkaloid has been isolated to which the structure of 11-methoxydiaboline has been assigned (1091).

6. Strychnos rondeletiioides Spruce ex Bentham, Jour. Linn. Soc. 1:104. 1856.

Venezuela: Amazonas: "7/9 km de Yavita hacia Pimichin", Steyermark & Bunting 102920.

7. Strychnos macrophylla Barbosa Rodrigues, Vellozia, ed. 2, 1: 33, pl. 2, fig. A. 1891.

Brazil: Amazonas: near Manaus, Aleixo, on terra firme, W. Rodrigues 8922 (INPA).

9. Strychnos araguaensis Krukoff & Barneby, Mem. N. Y. Bot. Gard. 20(1):24. 1969.

Brazil: Goiás: Araguaina, elev. + 300 m, Irwin et al. 21182; Mato Grosso: R.M. Harley et al. 10811 (E) (ca 290 km N. of Xavantina, dry forest), R.R. DeSantos et al. 1802 (E) (ca 310 km N. of Xavantina), 1489 (E) (ca 281 km N. of Xavantina), J.A. Ratter et al. 1199 (E) (ca 285 km N. of Xavantina).

This species was known from 3 collections and the present collections confirm the fact that it is confined to a dry low forest in a transition zone between high Amazonian forests and open savannas. S. peckii which closely resembles S. araguensis in vegetive characters, is found in the same localities but in gallery forests.

11. Strychnos trinervis (Velloso) Martius, Syst. Mat. Med. Bras. 121. 1843.

Brazil: Paraná: Hatschbach 18992 (WAG), 20183 (WAG), 20186 (US), s.n. (1/11-1968) (US).

12. Strychnos panamensis Seemann, Bot. Voy. Herald 166. 1854.

Chromosome number : $2n=44$. Voucher: Guillen 201 cited in 7a: 29 (Annals Missouri Bot. Gard. 56:474. 1969).

Guatemala: Suchitepequez: near Nahualate, Krukoff 1971/15. Panama: Canal Zone: Croat 5077, 10165. Colombia: Choco: Munic. Riosucio, Rio Truando, Romero Castaneda 6099 (COL).

From mature seeds capable of germination (Guillen 201) Strychnine (0.1%) and Brucine (0.1%) were isolated. Immature and overmature seeds were not found to contain either of the two bases. This is the first time that these two alkaloids were identified with certainty in an American species of Strychnos. (109k). For the previous work with stem bark see (109b) and (7b).

13. Strychnos tabascanana Sprague & Sandwith, Kew Bull. 1927:128. 1927.

Mexico: Veracruz: Region de los Tuxtlas, 900 m, Mario Souza 3441 (MEXU); Oaxaca: Mario Souza 1722 (MEXU) Chiltepec), 1841 (MEXU) (Tuxtepec), Comisión de Dioscóreas 5491 (MEXU) (Temoxcal).

This is the first record of the species from Oaxaca, Mexico.

According to a private communication from Prof. G.B. Marini-Bettolo, from the root bark of this species (Humberto Barquero M. 104, 105 cited in 7a:30 and Boburg 101 cited in 7b:29) five alkaloids have been isolated. These are as follows: Tabascanin which is related to Retuline, an indolinic alkaloid previously found in the African species S. henningsii; Acetyl-tabascanin which is identical with Strychnosilidine recently reported in S. brasiliensis; two alkaloids, Strychnobrasiline and 10-methoxy-

-strychnobrasiline which belong to the isosplendine type present in African species S. splendens and Strychnobrasiline which was recently isolated from S. brasiliensis. (Farmaco (Ed. S.), in press).

15. Strychnos bahiensis Krukoff & Barneby, Mem. N. Y. Bot. Gard. 20(1):29. 1969.

Brazil: Bahia: Belmonte, Belem & Pinheiro 3228.

16. Strychnos eugeniifolia Monachino, Phytologia 4:209. 1953.

French Guiana: basin of Approuague River, DeGranville 100 (CAY), Oldeman B-535 (CAY).

18. Strychnos medeola Sagot ex Progel, Mart. Fl. Bras. 6(1):282. 1868.

French Guiana: basin of Approuague River: Oldeman T-77 (CAY), B-2279 (CAY). Brazil: Pará: basin of Rio Jarí, N.T. Silva 1758, 3408.

Silva 3408 is a voucher for samples of bark collected for chemical studies by Prof. Marini-Bettolo.

19. Strychnos toxifera Robert Schomburgk ex Bentham, Jour. Bot. Hook. 3:240. 1841.

Panama: Canal Zone: Barro Colorado Island, Croat 5425, 10945 (MO).

20. Strychnos tomentosa Bentham, Jour. Linn. Soc. 1:104. 1856.

French Guiana: Herb. Centre Cayenne 7930 (CAY). Brazil: Pará: Belém, Ipean, cult., N.T. Silva 3036; basin of Rio Jarí, E. Oliveira 4678 (IAN).

Silva' specimen is a voucher for the sample of leaves collected for chemical studies of Dr. N.G. Bisset.

3. Strychnos colombiensis Krukoff & Barneby, Mem. N. Y. Bot. Gard. 12(2):21. 1965.

Peru: Cuzco: prov. La Convención, Cordill. Vilcabamba, along the Mapitunari, c. 670 m, + 4 km from Apurimac, T.R. Dudley 11486 (NA, F, NY).

Two Dudley's collections are from the same locality. Dudley 10075 cited under S. peckii shows that this species ascend the Amazon almost to its source, whereas S. colombiensis cited above was known previously only from 3 collections on the Pacific coast of southern Colombia.

25. Strychnos pseudo-quina A. St. Hilaire, Mém. Mus. Paris 9: 340. 1822.

Brazil: Goiás: Irwin et al. 21584 (ca 12 km S. of Guara,

elev. + 550 m), 23993 (Chapada dos Veadeiros); Mato Grosso: David R. Hunt & José Ferreira R. 5729 & 6110 (Serra do Roncador), G. Hatschbach 23594 & 24266 (mun. Rio Brilhante, Casa Branca), J.A. Ratter et al. 395 (E) (2 km N. of Xavantina), D.R. Gifford G.102 (E) (ca 260 km N. of Xavantina).

This species was studied chemically by Marini-Bettolo and his coworkers and nor-dihydrotoxiferine of high purity and in large amounts (6%) was isolated from the stem bark (109f).

Pollen grains of S. pseudo-quina St. Hil. were studied and their description and drawings were presented. (I.F. Marques Valio & Maria Lea Salgado Labouriau, Rev. Brasil. Biol., 24(2): 124. 1964).

27. Strychnos amazonica Krukoff, Brittonia 4:284. 1942.

Brazil: Pará: basin of Rio Jarí, Nilo T. Silva 3429; Rondônia, basin of Rio Madeira, France et al. 8491 (MG, INPA).

This is the first record of the species from Rondônia.

31. Strychnos peckii B. L. Robinson, Proc. Amer. Acad. 49:504. 1913.

Costa Rica: Puntarenas: El General valley, + 900 alt., L.O. Williams 28692. French Guiana: south of Cayenne, Oldeman 1877 (CAY). Brazil: Pará: Belém, Ipean, cult. N.T. Silva 3037. Mato Grosso: G.C.G. Argent 6913 (+ 280 km N. of Xavantina, swampy gallery forest), J.A. Ratter et al. 1333 (K) (+ 240 km N. of Xavantina). Peru: Cuzco: prov. La Convención, about 8 km NE from Hac. Luisiana and Río Apurímac, alt. 910 m, dense rain forest, T.R. Dudley 10075 (NA).

L.O. Williams' collection is the first record of the species from Puntarenas. For our remarks on the Dudley collection, which is the new record for Peru, see under S. colombiensis, and on the two collections from Mato Grosso under S. araguaensis.

Silva's specimen is a voucher for the sample of leaves collected for chemical studies by Dr. N.G. Bisset.

32. Strychnos erichsonii Richard Schomburgk, Reisen 3:1082, hyponym. 1848; Mart. Fl. Bras. 6(1):274. 1868.

Panama: Darién: La Boca de Pierra, N. Bristan 1264 (MO). French Guiana: Oldeman 1641 (CAY) (south of Cayenne), B-2771 (CAY) (basin of Approuague), 1715 (CAY) (basin of Oyapock), Herb. Centre Cayenne 7858 (CAY) (Tampoc River). Brazil: Pará: Belém, Ipean, Pires & N.T. Silva 10439 (IAN); Amazonas: Manaus - Itacoatiara highway, Reserva Florestal Ducke, terra firme, France et al. 4794. Colombia: Amazonas (Quebrada Loretillo, afluente del Río Loreto-Yacú, en la frontera Colombo-Peruana, Fabriciano Diaz M. 57 (ECON).

Fabriciano Diaz 57 is a mixed collection. The specimen deposited at New York represents S. erichsonii, whereas the other sheets distributed under the same number are S. mitscherlichii var. mitscherlichii.

33. Strychnos gardneri DC., Prodr. 9:14. 1845.

Brazil: Minas Gerais: Irwin et al. 23645 (Serra do Espinhaço, elev. + 950 m), 24182 (Chapada dos Veadeiros, elev. + 1000 m).

36a. Strychnos mitscherlichii Richard Schomburgk, Reisen 2:451. 1848, var. mitscherlichii.

Brazil: Pará: Santarém, M. Silva & R. Souza 2570 (HAMP 37376); Acre: Rio Branco, terra firme, Vasconcelos & D. Coêlho s.n. (INPA 11048).

This is the first record of this species from the basin of Rio Tapajos and from Acre.

37. Strychnos solerederi Gilg, Bot. Jahrb. 25(Beibl. 60):40. 1898.

Colombia: Amazonas: Leticia, D.D. Soejarto 595 (K).

38. Strychnos darriensis Seemann, Bot. Voy. Herald 166. 1854.

Nicaragua: Sombrero Negro, near Rama, Carlos Berger s.n. (Jan. 1912) (NA). Panama: Canal Zone: Croat 8015 (MO). Colombia: Chocó: Río San Juan, Cuatrecasas 21142 (F). Peru: J. Schunke V. 3445 (F).

This is the first record of the species from Nicaragua.

39. Strychnos guianensis (Aublet) Martius, Syst. Mart. Med. Bras. 121. 1843.

Venezuela: Bolívar: "el drenaje de Rio Cuyuni, Steyermark et al. 104538 A. French Guiana: Oldeman B-480 (CAY) (south of Cayenne), B-2697 A (CAY) (basin of Approuague River), Oldeman T-781 (CAY) (upper Oyapoc). Brazil: Pará: basin of Rio Jarí, mata de terra firme, N.T. Silva 3156, basin of Rio Parú, Cavalcante 2529 (MG); Amazonas: W. Rodrigues 8858 (INPA) (near Manaus), Byron 266 (INPA) (Rio Auati Paraná).

40. Strychnos glabra Sagot ex Progel, Mart., Fl. Bras. 6(1):275. 1868.

Brazil: Pará: boca do Rio Juruena, fronteira Amazonas, Pará and Mato Grosso, Pires 3698; Amazonas: basin of upper Juruá, Froes 21765; Mato Grosso: Serra do Roncador, margin of Garapu airstrip, Prance et al. 59203.

The specimens listed above were mentioned previously (7b:26) as representing a possibly undescribed species akin to S. glabra, but of uncertain status due to lack of good flowers and fruits. They are interpreted here as a pubescent form of S. glabra, or possibly as pubescent branchlets of the same growing in full sunlight. They find a good match in Krukoff 9090, which in turn matches Krukoff 9062 (with immature fruits), 9098, and 9101, all from the basin of Creek Belém in drainage of Rio Solimões, Amazonas. All these specimens are from terra firme.

42. Strychnos bicolor Progel, Vidensk. Meddel. 1869:31. 1869.

Brazil: Distr. Federal: Chapada do Contagem, elev. + 1100 m, Irwin et al. 19481; Minas Gerais: Chapada dos Veadeiros, elev. + 1000 m, Irwin et al. 24015.

This is the first record of this species from the Federal District.

43. Strychnos panurensis Sprague & Sandwith, Kew Bull. 1927:132. 1927.

Panama: coll. undesign. 8166 (MO). French Guiana: "Fleuve Sinnamary, sur la crique Grégoire," Oldeman B-1653 (CAY).

This is the first record of this species from French Guiana.

46. Strychnos hirsuta Spruce ex Bentham, Jour. Linn. Soc. 1:106. 1856.

Brazil: Amazonas: Janauacá, L. Coêlho & D. Coêlho 37 (INPA).

Samples of this species (Pires 2638) were forwarded at our request to Istituto Superiore di Sanità, Rome (7a:63). According to a private communication from Prof. G. B. Marini-Bettolo, bark of the lower part of the stem and bark of roots show the same composition in tertiary alkaloids. These are still under investigation.

48. Strychnos melinoniana Baillon, Bull. Soc. Linn. Paris 1:256. 1880.

Surinam: L.B.B. 12038 (U). French Guiana: Sinnamary River, Oldeman B-1235 (P). Brazil: Amazonas: near Rio Maturacá, near the Venezuela border, Steyermark 104026.

52. Strychnos oiapocensis Froes, Bol. Tecn. Inst. Agron. Norte 36:143. 1959.

French Guiana: François Halle 1133 (P) and Oldeman 1180 (CAY) (Cacao, 60 km S. of Cayenne), Oldeman B-2114 (CAY) (basin of Approuague), Oldeman 2614 (CAY) (basin of Oyapock).

54. Strychnos atlantica Krukoff & Barneby, Mem. N. Y. Bot. Gard. 20(1):61. 1969.

Brazil: Pernambuco: Andrade Lima s.n. (6/2-1970).

The collector describes the plant as "cipó vigoroso ramando nas arvores de 8-10 m."

Calyx of this species is described here for the first time (corolla is not present on the above cited specimen): calyx microscopically puberulent externally, + 2 mm long, the free lobes up to 1.5 mm long, ovate, short-acuminate, stiffly hispidulous-ciliolate.

Samples of this species (Romeu-Belém 3712) were forwarded by us to Istituto Superiore di Sanità, Rome (7d:183). According to a private communication from Prof. G. B. Marini-Bettolo, the root bark yielded only tertiary alkaloids.

55. Strychnos rubiginosa DC., Prodr. 9:16. 1845.

Mato Grosso: Campo Grande, J.P.P. Carauta 758 (RB); Minas Gerais: Serra do Espinhaco, elev. + 1100 m, Irwin et al. 23152; Paraná: mun. Jaguariaiva, cerrado, Hatschbach 20402.

In 1969 we arrived at a new concept of this species and in 7b:98 we cited 14 known collections of it from the states of Piauí, Ceará, Pernambuco, Bahia and Mato Grosso. The present collections are new records of the species from Minas Gerais and Paraná.

Fruits on Irwin's collection are 2.7-3.4 cm diam.

56. Strychnos parvifolia DeCandolle, Prodr. 9:16. 1845.

(?)Rhamnus ruffus Velloso, Fl. Flum 1:96 and 2:tab. 148. 1825.

(?)Ziziphus rufa (Velloso) Martius, Flora 24, Beibl. 2, p. 65. 1841.

(?)Colubrina rufa (Velloso) Reissek, Martius Flora Bras. 11 (1):98. 1861.

Brazil: Pará: Santarém, M. Silva 1313 (MG), 1367 (MG). Paraguay: Pedersen 5122 (US).

The plant described and figured as Rhamnus ruffus by Velloso is doubtless a species of Strychnos, as recently brought out by M.C. Johnston (Brittonia 23(1):51. 1971), but its identity remains controversial. Velloso described the plant as a high-climbing vine with spines, glabrous leaves, and terminal inflorescences, evidently some member, therefore, of sect. Breviflorae.

The plate somewhat suggests S. rubiginosa, but this has pubescent foliage and is found in cerrados, not in coastal forest. Spines combined with terminal inflorescences might suggest S. nigricans or S. mattogrossensis, but the leaves illustrated cannot be reconciled with either. These leaves might illustrate those of a young stump-sprout of S. parvifolia, but do not resemble leaves of adult stems high on the vine. Inasmuch as an exact determination of Rhamnus rufus seems unattainable in the absence of specimens, it is preferable to discard the name as ambiguous, thereby ensuring the perpetuation of the posterior but well-known S. parvifolia DC.

59. Strychnos brasiliensis (Sprengel) Martius, Flora 24 (Beibl. 2):84. 1841.

Brazil: Distr. Fed.: Jard. Bot. Rio 109208 (RB); Minas Gerais: M. Kuhlmann 2581 (K) (Sapucaí-Mirim), Emmerich 1746 (R) (Poços de Caldas), L. Mattos & N. Mattos 15170 (SP) (Munic. Passa Quatro); São Paulo: Mello Filho 1270 (R) (Mojí-Guaçu); Paraná: G. Hatschbach 256, 18362, 19168 (WAG), 23061; Rio Grande do Sul: Brescia & Borsani 3333 (US). Argentina: Misiones, E. Claro s.n. (Posadas), E. Sesmero s.n. (18/5-1944), Montes 3265 (K) (Cantero); J. Couderc s.n. (Jan. 1968); Corrientes: Ibarrola 1479.

From the trunk bark (J. Couderc s.n.) spermostrychnine (I) and six new indoline alkaloids have been isolated and their structures and configurations determined. They were named: 12-hydroxy-11-methoxyspermostrychnine (II), Strychnobrasiline (III), 12-hydroxy-11-methoxystrychnobrasiline (IV), 10, 11-dimethoxystrychnobrasiline (V), Strychnosilidine (VI), and Strychnosiline (VII). (72).

64. Strychnos nigricans Progel, Mart. Fl. Bras. 6(1):280. 1868.

Brazil: Minas Gerais: Fazenda S. Marco, Belem 3788 (IAN); Guanabara: Rio de Janeiro: Grajau, Mello Filho 2682 (R).

65. Strychnos mattogrossensis S. Moore, Trans. Linn. Soc. II. 4: 392. 1895.

Brazil: Amazonas: basin of Rio Solimões, Lago Buiussú, M. Silva 2030 (MG); Maranhão: munic. Viana, Boiciquere, Froes 34923 (IAN); Rio Grande do Norte: Canguaretama, na Boca dos 7 buracas, Luiz Emygdio 1701 (R); Paraíba do Norte: Araça, Xavier 151 (R); Pernambuco: Pacatuba, Andrade Lima 68-5227; Bahia: Belém & Pinheiro 3110 and Belém 3512 (Marau), 3708 (Una), 3713 (Juçari), 3874 (vale do Rio Mucuri), Froes 12658 (basin of Rio Pardo), 12708 and 12735 (basin of Rio Santa Ana).

It is not possible to distinguish the sterile collections of S. mattogrossensis from S. nigricans. Even good flowering material is difficult to identify, but the two species are immediately distinguished by fruits. With the recent collections of

fruiting material we revised collections of this complex as it is represented in North Eastern Brazil. It now appears that S. mattogrossensis was collected in Maranhão, Ceará, Rio Grande do Norte, Paraíba do Norte, Pernambuco and Bahia, states from which there are no collections of S. nigricans. The latter species of course is well represented from Minas Gerais, Espírito Santo, Rio de Janeiro and São Paulo. For the collections mostly sterile which were identified incorrectly, or with doubts, see Appendix VII (Supplement).

67. Strychnos schultesiana Krukoff, Mem. N. Y. Bot. Gard. 12(2): 78. 1965.

Venezuela: Mérida: Breteler 3989 (WAG), 4578 (WAG); Barinas: Breteler 3155 (WAG), 4003 (WAG).

69. Strychnos poeppigii Progel, Mart. Fl. Bras. 6(1):282. 1868.

Peru: Huánuco: Tingo María, J.D. Dwyer 6265 (LA); Loreto: near Contaminá, Schunke 940.

70. Strychnos tarapotensis Sprague & Sandwith, Kew Bull. 1927: 131. 1927.

Peru: San Martín: Mariscal Cáceres, alt. 500 m, J. Schunke V. 3187.

APPENDIX VII (SUPPLEMENT)

Changes in the identifications

Cited originally as Cited later as

Belem	3110 (fl.)	<u>nigricans</u>	(7b:70)	<u>mattogrossensis</u>	(11th Suppl)
"	3512 (sterile)	"	(7d:184)	"	"
"	3708	"	"	"	"
"	3713	"	"	"	"
"	3874	"	"	"	"
Xavier	151	"	(1:315)	"	"
Froes	12658	"	(2:23)	"	"
"	12708	"	"	"	"
"	12735	"	"	"	"
"	34923 (fl.)	"	(7b:70)	"	"
Mello Filho	1701 (sterile)	"	"	"	"
Pedersen	5122	"	<u>brasiliensis</u>	(7b:67)	<u>parvifolia</u>

Corrections

7d:180 Strychnos pseudo-quina not Strychnos pseudo-guina

7d:182 Strychnos guianensis not Strychnos quianensis

7b:45 Altson not Alston

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(In order to conserve space, we are citing here only papers not cited in Supplements VII - X).

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